ADVECTIVE-STATISTICAL FORECASTS OF RAINFALL: AN OPERATIONAL SYSTEM

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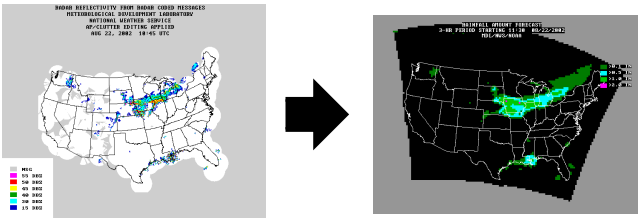
Purpose:

- Automated monitoring of radar, satellite, lightning observations and numerical model output to provide guidance on the potential for locally-heavy rainfall
- Direct forecasters' attention to areas at risk for flash flooding over the next 3-h period



0-3 Hour QPF products:

- **Forecasts:**
  - Probability of rainfall exceeding 0.1, 0.5, 1, 2 inches (2.5, 12.5, 25, 50 mm)
  - Categorical rainfall amount forecast
  - Probability of cloud-to-ground (CG) lightning
- Forecasts are for highest local amounts within 40-km grid boxes
- Covers conterminous United States
- Updated twice per hour

Input data:

- 10-km radar reflectivity mosaic
- 15-minute CG lightning strike count
- GOES 11-μ channel temperatures
- Wind vectors, humidity, stability, precipitation forecasts from Nested Grid Model or Eta model

Advective-Statistical Technique (ADSTAT)

- Application of Model Output Statistics (MOS) approach to an advective model of precipitation
- Generated many advective forecasts of reflectivity, satellite IR temperature, lightning strike fields from historical data
- Forecast fields were collated with verifying radar rainfall estimates (WSR-88D Stage III radar/gage analyses)
- Used linear regression to relate forecasts to probability of rainfall exceeding various thresholds
- Regression equations relate variables such as reflectivity level, satellite temperature, NWP model precipitation to probability of rainfall exceeding some threshold amount in the forecast area
- Regression equations are used to produce probability forecasts from real-time advection forecasts

Operational Considerations

- Uses mean 700-500 hPa wind vector as advective velocity
- Categorical amount forecasts derived by comparing probabilities to pre-determined threshold values
- Model and postprocessing runs < 2 minutes on IBM RISC workstation at NWS headquarters
- Output disseminated in GRIB format
- Graphical version of output available at: http://weather.gov/mdl/

Advantages of ADSTAT

- Makes direct use of remote-sensor observations; new precipitation systems immediately incorporated in forecasts
- Fast running time
- Explicitly developed to forecast conditions conducive to heavy rainfall

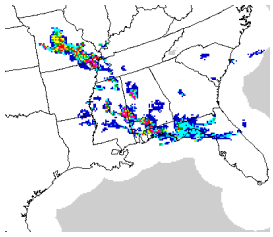
Shortcomings of ADSTAT

- No explicit model for evolution of precipitation rate field
- Limited ability to forecast rainfall from incipient convection (captures some when NWP model forecasts it)
- Present version does not capture terrain or land/sea boundary effects

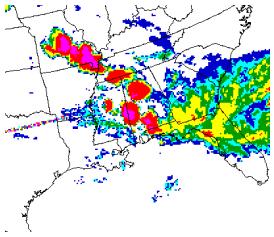
Example case: 1200-1500 UCT 4 April 2001

- Heavy rainfall imminent over southeastern United States
- Fields shown: initial-time observations near 1115 UTC; probability and categorical forecasts; verifying Stage III rainfall observations

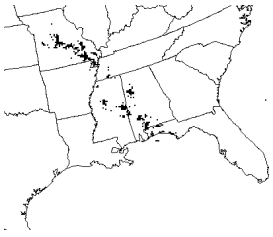
Initial-time radar



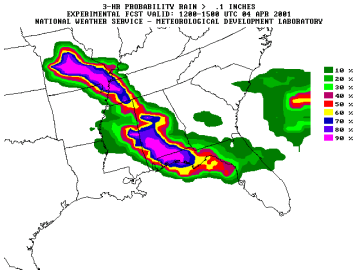
Initial-time satellite



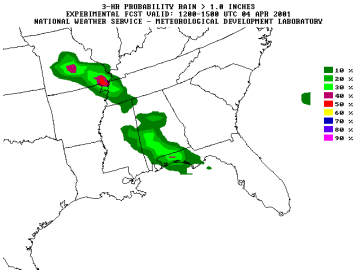
Initial-time lightning



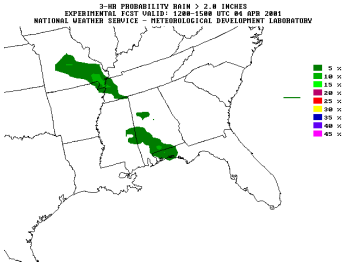
Probability 0.1 inch



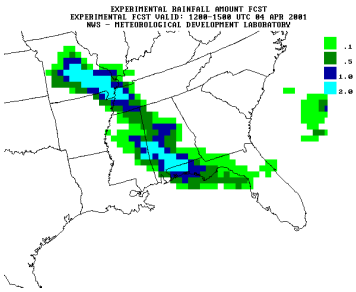
Probability 1 inch



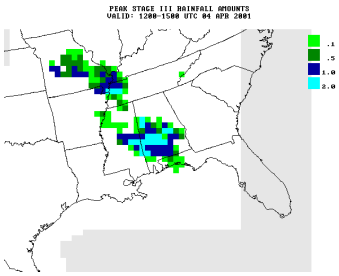
Probability 2 inches



Categorical rainfall forecast



Verifying Stage III estimates



Comparison: Detection of 0.1-inch and 1-inch Rainfall Events
ADSTAT vs. Operational 12-km Eta model

- For cases 1 May - 30 July 2002, determined threshold values of Eta 3-hour precipitation and ADSTAT probability that yielded the same probability of detection (POD) of observed 0.1-inch and 1-inch rain events
- Total 43,000 cases in central and eastern U.S., valid period 2100-0000 UTC (late afternoon), 17% with 0.1-inch rainfall, 4.2% with 1-inch rainfall
- Compared bias and false alarm ratio
- ADSTAT gave appreciably lower bias and false alarm ratio for same POD